Assessing multisensory tasting experiences by means of customized soundscapes

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Summary

We review three methods, which are all intended to address the influence of sound on the perception of taste. In the analysis of the results of the first method, we take into account the added value of a progressive interaction of the participants in their perceptual experiences. Furthermore, with two new methods that we introduce, we intend to elaborate on the claim that customized sonic cues can have a significant influence on taste, and in the decision-making process for consumption. We believe that the ideas here presented may help similar cases in getting closer to real gastronomic situations. And we open a discussion, looking for new experiences that could follow our approaches towards novel insights.

1. Introduction

There's growing awareness of the significance of the quality of the soundscape in restaurants, pubs and similar places as well as of its influence on people's experiences: research has shown that several psychoacoustic factors can play a role [1,2]. Moreover, the contemporary gastronomy community envisions for the near future fully multisensorial tasting experiences. Recent studies highlight the multisensory nature of taste/flavour perception in humans, introducing several methods to study the effect of auditory stimuli on taste (see [3], for an overview). Studying the effect of sound on taste is particularly intriguing because it is not immediately evident how, or why, what we hear can influence what we taste. Is it related to the influence of attentional control over perceptual selection that becomes enhanced when the signals from the senses contain congruent perceptual information [4]? Is it related to crossmodal correspondences, such as association? Or is it a matter of multisensory integration at the neurophysiological level? For an overview see [5]. This presentation refers to a project where experimental psychologists, contemporary gastronomes and acousticians are working as one team to study the influence of sound on taste during a gastronomic experience. We start by reviewing an existent experiment recently performed [6]. Here, we combine crossmodal theory with a participative experiment, in order to create sound-taste pairs that putatively match each other. The results outlined here demonstrate that what we hear can exert a significant influence on our perception of taste, even when the participants' own responses are used to assess congruency. And such responses show that certain associations are more related to subjective interpretations than others. Next, we review two new experiments that will be running in the next months (the first in 2015 and the second with timeframe to be confirmed). The first one proposes assessing the emotional connections that information associated to auditory stimuli can bring into the gastronomic experience. Informing the subjects that the music they are exposed to while eating is the same as being used by the chef for artistic inspiration - while conceiving the food - would modify the food's experience by enhancing its taste. Michel and his colleagues [7] developed a similar experience focusing on visual design, reporting that the use of artistic (visual) influences can enhance a diner's rating of the flavour of a dish. The second new-running experiment proposes the evaluation on how a customized soundscape can influence decision-making while choosing a menu in a restaurant facility. Existent multisensory congruence theories already approached sensory cues as triggers for priming [8,9,10]. On our case, we propose that customized soundscapes could work as a guide for the client through the decision-making process. Finally, we believe that the combined results of these 3 experiments may become a solid starting-point for experiments involving brain-scanning imaging. Such starting point could blend with existent literature on brain research that focuses on sound [11,12] and taste [13], among others.

2. Methods

2.1 Using Sonic Seasonig as part of Multisensory Tasting Experiences

Twenty-four participants took part in the study. There were 12 females and 12 males (mean age: 22.7 years, SD 5.9). The participants were informed that they would be asked to eat samples of chocolate and to listen to different types of music. The experiment lasted for around 40 minutes. The chocolate samples consisted of three different flavours, namely bitter, medium and sweet chocolate. The samples were prepared at The Chocolate Line factory in Bruges by the award-wining Belgian chocolatier Dominique Persoone. More information about the work of Dominique Persoone can be accessed through his website **www.thechocolateline.be.** The participants tasted several chocolates during the course of the experiment, and each chocolate sample had the same small circular design, approximately 1 cm in diameter. The soundtracks were produced in collaboration with the IPEM, Dept. of Musicology, at Ghent University. They were created using Steinberg Cubase and Pure Data. Each soundtrack was produced on the basis of the literature to be congruent with each of the three chocolate samples [14,15]. The music samples – as they were used in the experiment - are available at the website **chocolatetriad.tumblr.com** (See Figure 1 for a spectrogram of the sound samples). A control experiment was conducted to check if people would be able to associate each soundtrack as intended. Seventy-eight participants rated the soundtracks on a bitter-sweet scale. Results show that the evaluation outputted as expected (Reinoso Carvalho et al., in press). The experiment took

place in a darkened experimental room at IPEM. Three small booths were set up. The soundtracks were presented over headphones.

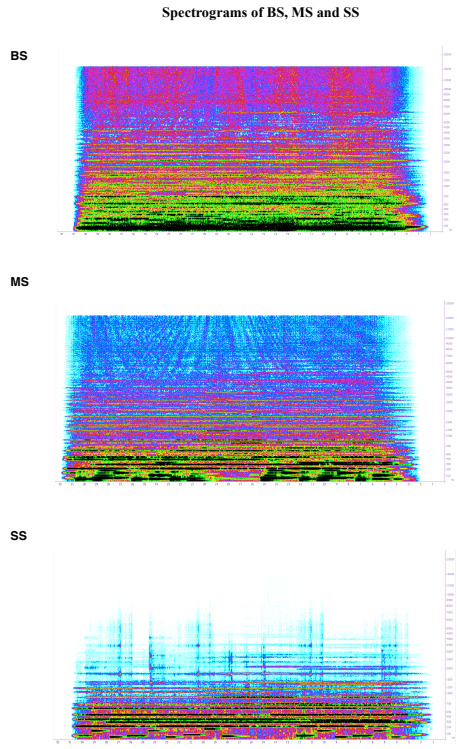

Figure 1. Spectrograms of the sound samples

In the first part of the experiment, the participants had to match a chocolate sample with a soundtrack. Each combination had to be rated on a Likert scale going from "very bad" to "very good".

In the second part of the experiment, the flavour sample (chocolate) and the sound sample (soundtrack) were presented in pairs. The objective was to study the influence of the soundtrack (as compared to silence) on taste. The order of presentation was counterbalanced across participants. Each pair of stimuli was presented in a random order as well. Each time a piece of chocolate was tasted, the participants rated their experience. For each possible combination chocolate/soundtrack, there were two Likert scales. One scale for the evaluation of flavour without listening to any soundtrack and the other while listening to one of the soundtracks. The scales went from very bitter, passing through neutral to very sweet. The participants had an additional third question where they were asked to compare the two ratings. During the whole process, the participants had the opportunity to drink tap water and eat white bread to neutralize the flavour. For final results and extensive discussion on the method, see [6].

2.2 Evaluating the influence of musical personalization on tasting experiences

We anticipate evaluating around 100 participants that will be subdivided in 4 groups (1 group per condition). The participants will be informed that they would be asked to eat chocolate while listening to music. The experiment will last around 10 minutes. Our confirmed partner for this experience is the same Belgian chocolatier that participated in the previous experiment, Mr. Dominique Persoone. While preparing the food samples (taste stimuli), he will use one song as source of inspiration (sonic stimuli). The selection of the song will come out from a discussion between the scientists involved in this project and the chef himself. The experiment will take at The Chocolate Line shop in Antwerp during April-May 2015. A place inside the shop will be adapted for experimental purposes. Unlike the previous experiment, in this case we are interested in showing the visual characteristics of the food sample. Therefore the lightening of the room has to be taken into consideration. The soundtracks will be presented over headphones. A between-participants experimental design will be adopted, where each group evaluates one of the 4 existent conditions. The results of the experiment should be the comparison between the obtained data. Table I presents the referred conditions and also resumes the verbal information to be passed to the participants during the experiment. In all cases, even though the information regarding the production process of the food sample varies, the food sample will always be the same for all participants, in all conditions. Two additional features are still being analyzed if they are worth to be included in this method. First, is the option of participants eating as much as they want and use this data for further comparison. And second is to consider the timeframe that each participant is willing to invest in fulfilling the experimental process.

Table I. Conditions AB,D,C,D of the experiment (2.2)

Condition	A	B	C	D
Method	Taste while listening to the soundtrack	Taste in silence	Taste while listening to the soundtrack	Taste while listening to the soundtrack
Verbal Information	*The food sample is part of an industrial batch. No information regarding the sonic stimulus is passed.*	*The food sample was hand-crafted by the Chef.*	*The food sample was hand-crafted by the Chef. Moreover, the Chef used the sonic stimulus as inspiration during the creative process of this edition.*	*The soundtrack has been chosen by scientists to match the chocolate's tasting experience.*

2.3 Soundscapes as congruent cues to influence decision making while choosing a restaurant's menu

This experiment is going to be developed in association with a restaurant facility. Such restaurant should be similar to a university's catering, where clients are able to choose one dish from an existent variety. The area of influence of the soundscapes is the path that clients follow while choosing the menu (not necessarily where they eat). Consequently, it is necessary to be aware of such path for the placement of the system of speakers to be used. The electroacoustic system must be able to overcome the existent background noise for the required situations. Therefore, an acoustic characterization of the referred area of the restaurant might be necessary. Each soundscape produced for this experiment will be associated to one type of food or menu. For example, an ocean/beach soundscape may be associated to dishes that include fish. Rainforest soundscapes may be associated to tropical or even vegetarian dishes, and so on. A control survey will be developed to validate such associations before using them in-situ. Furthermore, the experiment will be developed during several days. Each day, one pair (soundscape/menu) will be evaluated. Results will be based on the comparison between patterns of sold menus under the influence of the soundscapes versus previous patterns, where the same menus were sold without the influence of the sonic stimuli. It is also important to evaluate the repeatability of this experience. Thus, it is expected to evaluate each pair of soundscape/menu more than once. Two additional features are still being analyzed if they are worth to be included in this method. First, a small questionnaire handled while clients are paying may be necessary to improve the evaluation process. And second, more relevant information from the restaurant's database may be needed to improve the evaluation process (i.e. sales patterns related to the season, gender, hour of the day, etc).

3. Discussion

The results of the first experiment (2.1) show that the theoretical references used as baseline while constructing the bitter soundtrack are, indeed, effective [14,15]. By allowing participants to add their opinion, we were able to detect specific cases where the modulation of taste is not evident. Therefore, the participant's option to individually-match their pairs of sound and taste provide us with a new tool to improve the assessment of results. Consequently, the method also helps to achieve one of the main objectives of the present research: namely to pursue more personalized gastronomic situations, allowing participative experiences to move the research increasingly towards real-life experiences. Reinoso Carvalho and his colleagues have recently mentioned the importance of taking laboratory-only tests to in-situ environments, where external influences should play an important role towards obtaining more reliable results [16]. Participative experiences can output more clear results,

especially when the sound-taste matching process becomes more complex and challenging, such as the ones that we could find in multisensory experiences designed for restaurants (See [6] for an overview of the results). Withal, this method can be easily implemented in-situ. And individual experiences using headphones could be further enriched by letting the participant organize - or even create - his/her individual playlists. And sonic-seasonig experiences could blend with visual ones, such as the one recently reported by Spence and his colleagues [17], where more than 3000 participants tasted wine under different combinations of customized lightening and soundscaping.

The focus of the first upcoming new experiment proposal (2.2) is analyzing the potential added value brought by the emotional connections that the sonic information can bring into the tasting experience (i.e. Does the participant knows and/or likes the song?). We also intend analyze the potential added value brought by the emotional connections that the music-taste preference of the chef can bring into the tasting experience of the customer. Note that, the experiment will be developed in the shop of the correspondent chef. So, the participants submitted to evaluation will be considered as clients and most of them may be familiarized with the existent offer. Therefore, the added value of this method proposal is to quantify how far can the costumer's experience be enriched by means of extra sensorial add-ons. Some chefs have openly reported the usage of music as source of inspiration for their creations. Massimo Botura can be mentioned as an example of this trend. He considers himself as an audiophile [18]. And his love for jazz is tangible in one of his creations, namely "Tribute to Thelonius Monk" [18]. Moreover, the cultural and social connections between the chef and the participants may outcome as relevant data in the obtained results. It is also important to highlight that, in our case, even though the technical and musical aspects of the sonic stimuli to be used are not the main focus of the experiment, their technical and musical characterization will be strongly considered during the discussion. This way, we may find psychophysical patterns associated to multisensorial perception that could help enriching the obtained results.

Moving forward to the second upcoming experimental method (2.3), a better understanding of the acoustic quality and the background noise is a key factor when implementing an electro-acoustic system. Consider that, for this method proposal, we are proposing the usage of soundscapes, and not necessarily music. And such soundscapes are meant to remain as background stimuli. The presence of excessive background noise could limit the possibilities of implementing such experience (see [19], for a review of the influence of noise on the perception of food and drink). An acoustic characterization of the space may be the needed towards a better control of the existent background noise. Another key factor in this experiment is assessing its repeatability and significance. Previous experiments have approached similar situations, and each one considered a different sampling criteria. North, Hargreaves & McKendrick evaluated [20] how can in-store music influence on wine selections. Their experiment assessed 2 different soundtracks up to a total of 80 costumers, over a 2-weeks period. Sands, Oppewal & Beverland went further by reporting [21] results based on 312 costumers' experience. They used logit models to assess the effects of the in-store events along with those of various traditional store attributes. Woods and his colleagues concluded [22] that background sound unrelated to food diminishes gustatory food properties, such as saltiness and sweetness. For this experience, they worked with 48 participants. Areni & Kim reported results [23] that indicate that classical music influenced shoppers to spend more money if comparing with playlists based on Top-forty charts. They gathered data during approximately 3 months, 2 days a week, 5 hours a day. We will use these four examples, along with the capabilities of the catering partner, as main references to define a reliable sampling approach.

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